REMARKS/ARGUMENTS

Reconsideration is respectfully requested of the Official Action of May 17, 2004 relating to the above identified application.

With entry of the foregoing amendment, the claims in the application are 1, 3, 5, 7 to 9, 11 to 16 and 19 to 25.

The rejection of Claims 1, 3, 7 to 9, 11 to 16 and 19 to 24 under 35 U.S.C. § 103(a) as allegedly obvious in view of *Hirooka, et al.* (US 5,330,813), taken with *Milaniak* (US 5,366,765) is traversed and reconsideration is respectfully requested.

The invention described in this application is directed to providing a solution to a problem observed in the industry relating to carburization of metallic components. Carburization of metal parts such as engine parts is carried out to increase wear resistance. However, as explained in this application (pg. 1, lines 23, et seq.), there is a risk in carburization reactions for the materials to run off of the metal parts in the oven and for the boron compound to vaporize (pg. 2, lines 4-14). This in turn, applicants have determined, leads to damage of heating elements and the ceramic lining of the carburization furnaces.

A person skilled in the art faced with this problem would find no suggestions in *Hirooka* or *Milaniak* as to how to solve this problem or any suggestion as to what causes the problem of damage to the heating element and furnaces. The present invention addresses that problem and provides a method and composition for surface hardening of metal surfaces by applying a paste, semi-liquid or liquid substance which forms a boron glass and a magnesium-silicon compound in a certain weight ratio.

Hirooka is concerned with the formulation of a protective coating in the form of a patch for many different types of processes. The "patch-idea" proposed by *Hirooka* is for use under a myriad of conditions including nitriding, carburizing and oxidizing processes. All these processes have absolutely different atmospheres (reducing, oxidizing, nitrogen and carbon emitting atmospheres) and process temperatures and it is not shown that the compositions given in the patent are suitable under any and every imaginable process condition. Thus, *Hirooka* has catalogued any and all technically available kind of oxide materials for use in the composition of their patches. *Hirooka*'s list of oxides is very unspecific as to which process they are intended for. It is indisputable that zinc oxides, alumina, zirconia, titanium oxide and all the other oxides cited in *Hirooka* are helpful additives in protective compositions. This is known from other patents and literature about protective coatings; but, specific properties or specific actions of the large number of different oxides cited in *Hirooka* are not given anywhere in the citation.

Therefore, specific properties such as a flow preventive effect or an effect on the temperature of evaporation of the applied composition cannot be deduced from this patent.

Hirooka discloses forming a patch in the form of a tape or film which is a pressure sensitive adhesive for preventing carburization and hence would not have faced the problems addressed by applicants in this application (see pgs. 1 and 2). *Hirooka* contains no hint of how to deal with the problem of high evaporation rates of boron oxide or borate which in turn causes problems such as decreasing the lifetime of ceramic linings and heating elements. There is no disclosure in *Hirooka* of any existence of problems of high evaporation rates when following the teachings of that reference. Hence, as *Hirooka* observed no excessive evaporation or vapor

pressure, there would be no reason or motivation to switch from one additive to another for the application of a substance capable of forming boron glass.

Not aware of the problem discussed by applicants herein, *Hirooka* cannot suggest to anyone skilled in the art that there would be an expectation of success. *Hirooka* fails to teach any solution to the problems discussed in this application and, in particular, fails to recognize the problem of evaporation of boron compound. Clearly, *Hirooka* fails to teach that a select group of magnesium silicon compounds offers a solution to this problem.

This can also be seen from the examples given. There are eight examples given, six of which are focused on carburization, one on nitriding (ex. 6) and one on oxidizing (ex. 7). Within the carburizing examples, the only additives mentioned are:

1. boron oxide, no additive oxide
2. boron oxide, titanium oxide
3. sodium borate (borax), phenyl boric acid
4. sodium borate (borax), phenyl boric acid (same as ex. 3)
5. boron oxide, titanium oxide and Aerosil (a special kind of silica)
8. boron oxide and iron oxide.
6. n.a. nitriding / tin powder
7. n.a. oxidizing / boron oxide, titanium oxide, borosilicate (glass)

All the other oxides cited by *Hirooka* are not used in any examples and one is left to speculate as to which oxide can be used in what process! Specific properties of oxide additives cannot be detected from the examples or the description.

Hirooka is totally silent on the problem of known hardening protection compositions based on substances which form boron glass having the tendency of running off in the oven during the hardening operation. This is particularly a problem after incomplete drying or due to binding of moisture from the atmosphere by the composition since the viscosity of the boron compounds is greatly reduced by water at a high temperature. Moreover, at carburization temperatures of 900° to 980°C the boron compound can vaporize until vapor pressure equilibrium is established. If this occurs, there results a decrease in the protective action due to the protective layer becoming thinner. Moreover, the oven lining, which contains silica containing bricks, and furnace equipment can also be attacked under those conditions.

The present applicants, faced with these problems in the industry, sought for a way to improve the situation. Applicants have focused mainly on the low pressure gas carburization process of steel, a process which in recent years is more and more important in the industry. This process is a particular one and faces some special problems when protective coatings are used. Here, the steel parts are carburized at temperatures between 800 and 1000°C under a vacuum of 1 – 200 mbar (approx.).

For use in these processes, protective coatings must be selected very carefully, and, of special importance, the evaporization of boron oxides or borates or other oxides from protective coatings must be prevented, as such oxides would deposit on the internal heating elements or on the ceramic limiting of the furnaces, thus destroying these elements by corrosive attack. Also, the evaporation and re-deposition of boron oxide or borate on different parts of the treated surfaces must be prevented.

Thus, it was surprisingly found that the addition of magnesium-silicon compounds to the hardening protection compounds of the present invention would reduce the risk of running off of the treating material and reduce the vapor pressure which in turn reduces the risk of attack on the oven lining. This solution to the above-described problem is not even hinted at by *Hirooka*.

It was the outstanding discovery by applicants that magnesium silicates, especially in the form of magnesium trisilicate, are materials which decrease the evaporation temperature of boron oxides or borates such that the rate of evaporation under low pressure is sufficiently low so that these compounds (boron oxides or borates) can be used as protective coatings in such low pressure gas carburizing. Apart from this, it was found that these boron oxide – Mg-trisilicate compositions, of course, can also be used successfully in standard gas carburizing atmospheres. In such atmospheres, they also exhibit the effect of low evaporation rates and lead to an increased lifetime of ceramic linings and heating elements, as well as a reduced flow effect on the parts.

Hirooka does not disclose the use of paste-like or lacquer-like materials containing magnesium-silicon compounds. Only patches are shown and *Hirooka* does not teach the interchangeability of applicants' magnesium-silicon compounds with patches containing other oxides. Furthermore, the problems discussed above are not addressed in the *Hirooka* patent. Therefore, persons skilled in the art faced with those problems would not be lead to find a solution by reading the *Hirooka* patent.

The *Milaniak* patent teaches the use of a slurry for coating super alloy surfaces. However, the patent is limited to coating super alloy surfaces with an aluminum coating termed

an "aluminide protective-coating." These coatings of *Milaniak* are for protection against heating-gas corrosion and heating gas oxidation; see col. 1, lines 16-21. Thus, the teaching of a slurry to apply an aluminum coating for protection against corrosion and oxidation would not suggest the application of a paste, semi-liquid or liquid of a boron glass together with a magnesium-silicon compound which unexpectedly results in reducing running off of the material when coated on a metallic surface in a carburization process. No equivalence or interchangeability has been established in the Office Action as to the aluminide coating and carburization.

Milaniak does not disclose using boron oxide or borate used for building up the protective coatings or metallic surfaces. Hence, the problems facing workers in this field as discussed on pages 1 and 2 of this application; namely, high evaporation rates of such materials causing the decreasing lifetime of ceramic linings of furnaces and heating elements are not discussed and, therefore, person skilled in the art seeking solutions to these problems would find no useful information in *Milaniak*.

Therefore, it is apparent that there is a lack of motivation in the Examiner's combination of references, and, consequently, a person skilled in the art would find no reason, suggestion or motivation to combine the two references to arrive at applicants' invention. Accordingly, it is respectfully submitted that the rejection is improper and should be withdrawn.

The examiner alleges that the *Hirooka* document "teach the invention substantially as claimed." Applicants disagree for a number of reasons including the fact that recognition of a problem is part of the invention and *Hirooka* fails to recognize the invention. See the Manual of

Patent Examining Procedure, § 2141.02, page 2100-119-August 2001. "A patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the 'subject matter as a whole' which should always be considered in determining the obviousness of invention under 35 U.S.C. § 103".

The *Hirooka* patent contains no hint whatsoever as to what may cause the deterioration of heating elements or ceramic linings of a carburization furnace. Not only does *Hirooka* provide no information about existence of such a problem but there is no hint or suggestion as to how to overcome these problems.

As previously explained, it is the evaporation of boron oxides, borates, and other oxides that is the reason for these problems. The solution of this problem; namely, the use of magnesium silicates particularly magnesium trisilicate in order to reduce the rate of evaporation is not described in the *Hirooka* patent. The Official Action alleges that a person skilled in the art would be led to select talc in order to obtain the best anti-carburizing coating with the best ability to stay in place. However, the use of talc is not suggested in the *Hirooka* patent for this purpose and therefore motivation is lacking.

The *Hirooka* patent is directed to a wide variety of subjects including preventing carburization, preventing nitrating, preventing oxidation of metallic parts. For that purpose, *Hirooka* discloses a patch or mask to prevent the contact of the portion of the metal with the oxidizing atmospheric gas. The coating of the masking material mentioned by *Hirooka* is a powder having a chemical with anti-carburization, anti-nitrating or anti-oxidation action blended

with a small amount of a binder and a solvent. Thus, *Hirooka* covers a wide range of material under a wide range of conditions and provides no detailed information as to precisely which materials to choose under what conditions. Thus, a large number of materials are set forth in the reference in column 3 beginning at line 33.

Adjuvants are suggested to accelerate the dispersion of the particular material into the binder. See column 3, line 47. Among the many adjuvants selected by *Hirooka* is talc and "magnesia". See column 3, line 51 to 56.

Nowhere in the *Hirooka* patent is there a teaching that by making a particular selection that it would be possible to prevent the attack on heating elements and furnace lining walls. The Official Action admits that the *Hirooka* patent does not teach the application of the composition in the form of a paste, semi-liquid or liquid and relies upon *Milaniak* as an alleged "functional equivalent" to show the method of applying a coating by application of the slurry. The Official Action notes that *Milaniak* is considered to be "analogous art" because it is related to the problems addressed by the present invention, particularly the application of a powder material onto a metal surface. However, applicants point out that *Milaniak* is not in anyway concerned with a problem that is facing applicant as described in the present application; namely, solving the problem of attack of heating elements and ceramic linings of carburization furnaces. A person faced with these problems would find no hint or suggestion in *Milaniak* as to this problem or how to overcome the problem. Formation of aluminide coatings to protect metallic surfaces from oxidation and corrosion as described by *Milaniak* is not comparable to the forming of anti-carburizing coatings as described in the present application. Furthermore, *Milaniak* is unrelated

to the technology of *Hirooka* as they belong to completely different technical fields. Consequently, there is no basis in terms of a sound scientific fact which establishes that the use of a slurry which may be well suited for forming aluminide coatings can be used interchangeably with anti-carburizing coatings. No equivalence or interchangeability has been established by the Official Action.

Applicants wish to emphasize that the problem presented in the *Milaniak* patent is to provide a protection of metallic surfaces against corrosion and oxidation; see column 1, lines 16 to 21. As described in column 2 of *Milaniak*, a slurry consisting of aluminum, halide compound activator and an organic thickening agent is used for the formation of the protective coating. This coating is formed by diffusion of aluminum into the substrate material.

The present invention refers to a completely different problem; namely, the problem of attack of heating elements and furnace ceramic linings. The present invention relates to hardening compositions which are not comparable to protection against corrosion and oxidation. Thus, materials used for forming a hardening composition according to the present invention are not comparable with materials used in the *Milaniak* patent for protection against corrosion and oxidation.

In *Milaniak*, aluminum is used for the formation of the protective coating. In the present invention, the hardening composition is formed by completely different materials.

Applicant submits that the problems facing applicant are entirely different from those facing *Milaniak*. In *Milaniak*, it is essential to provide a slurry consisting of aluminum and additional components so that the aluminum may diffuse into the substrate.

The hardening composition in the present application is compounded in such a way that the evaporation problem is solved. This means that the hardening composition contains components forming boron glass and magnesium silicon compounds in order to prevent evaporation of boron oxides or borates. Boron oxide or borates are not used in the *Milaniak* patent and therefore the problem according to the invention is not present or apparent in the *Milaniak* environment. Applicants respectfully submit that the slurry of *Milaniak* and the patch of *Hirooka* are not functional equivalents and therefore a person skilled in the art would not be led to interchange them or to use them as substitutes one for the other. In the *Hirooka* patent, the formation of the film is used for building up a pressure sensitive adhesive tape around the substrate. See column 2, lines 55 to 68. In contrast in the *Milaniak* patent, the slurry is made in such way that the aluminum can diffuse into the substrate. Hence, there is no coating such as a tape around the substrate. Thus, the use of a slurry for forming a coating against oxidation and corrosion described in *Milaniak* is not the functional equivalent of a patch used in the anti-carburizing techniques of *Hirooka*.

To establish a *prima facie* obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure, *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

In determining the propriety of the Patent Office case for obviousness in the first instance, it is necessary to ascertain whether or not the reference teachings would appear to be sufficient for one of ordinary skill in the relevant art having the reference before him to make the proposed substitution, combination, or other modification." *In re Linter,* 458 F.2d 1013, 173 USPQ 560, 562 (CCPA 1972).

Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. *In re Fine,* 837 F2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones,* 958 F2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills,* 916837 F2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).

A statement that the modifications of the prior art to meet the claimed invention would have been "'well within the ordinary skill of the art at the time the claimed invention was made'" because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* obviousness without

some objective reason to combine the teachings of the references. *Ex parte Levengood,* 28 USPQ 2d, 1300 (Bd. Pat. App. & Int. 1993).

Arguments in support of patentability discussed above apply to the new claim 25 with equal emphasis.

In view thereof, it is respectfully requested that the rejections be withdrawn and that the application be allowed at the Examiner's earliest convenience.

Respectfully submitted,

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